

Amendments to the Specification

Please insert the following new heading and paragraph on page 1 before line 3.

Cross-Reference to Related Application

This application is a continuation of Application No. 09/793,130 filed February 27, 2001.

The paragraph starting at page 1, line 11 and ending at line 20 has been amended as follows.

Up to now, a developing device equipped in an image forming apparatus of the electrophotographic system or the electrostatic recording system uses a two-component developer essentially including toner particles and carrier particles. In particular, in a color image forming apparatus that forms a full color or a multicolor ~~multi-color~~ image through the electrophotographic system, most of the developing devices use two-component developers from the viewpoint of hue, tone, or the like of the image.

The paragraph starting at page 2, line 15 and ending at page 3, line 11 has been amended as follows.

For example, there has been employed an optical developer density controller, a developer density controller of an inductance detecting type, or the like, which is disposed

in the vicinity of a developer bearing member (hereinafter referred to as "developing sleeve" since, in general, the developing sleeve is frequently used), or a developer carrying path of the developing container. The optical developer density controller grasps the toner density and controls the toner amount which is replenished to the developing device by utilizing a phenomenon that a reflection factor of a light irradiated onto a developer carried on the developing sleeve or a developer within the developing container is different depending on the toner density. The developer density controller of the inductance detecting type grasps the toner density within the developing container in accordance with a detection signal from an inductance head that detects an apparent magnetic permeability due to the mixture ratio of the magnetic carrier and the nonmagnetic ~~non-magnetic~~ toner in the developer and converts the detection signal from the inductance head into an electric signal, and replenishes the toner on the basis of a comparison of the toner density with a reference value.

The paragraph starting at page 4, line 22 and ending at page 5, line 1 has been amended, as follows.

Further, the toner replenishment due to the video count system is so controlled as to be set to an appropriate developer density more rapidly than ~~the two formers~~ if more toner is consumed due to a high-density image since the toner replenishment amount is calculated every time the image forming operation is conducted.

The paragraph starting at page 7, line 15 and ending at line 20 has been amended as follows.

Also, the above-described ~~above~~ problems are particularly remarkable in the case where a stop period of time after the stoppage of the image forming apparatus and before the restart ~~re-start~~ of the image forming apparatus is long, or in the case where the environmental variation is large during that stop period of time.

Please insert the following new paragraph on page 9 after line 22.

Fig. 9 is a flowchart showing the operation of an embodiment of an image forming apparatus for varying a time period extending from a time when the sub-mode is selected to a time when the sub-mode is changed to the main mode in accordance with the information detected by the detecting device.

The paragraph starting at page 15, line 12 and ending at line 25 has been amended as follows.

An example of the above developing device 44 is shown in Fig. 2. As shown in Fig. 2, the developing device 44 according to this embodiment is arranged so as to face the photosensitive drum 40, and the interior of the developing device 44 is sectioned into a first chamber (developing chamber) 52 and a second chamber (agitating chamber) 53 by a

partition wall 51 serving as a partition that extends in a vertical direction. In the first chamber 52 are disposed a nonmagnetic ~~non-magnetic~~ developing sleeve 54 serving as a developer bearing member that rotates in a direction indicated by an arrow, and a magnet 55 which is a magnetic field generating means is arranged within the developing sleeve 54 in an stationary manner.

The paragraph starting at page 18, line 1 and ending at page 19, line 3 has been amended as follows.

As described above, the two-component developer essentially includes the magnetic carriers and the nonmagnetic ~~non-magnetic~~ carriers, and the apparent magnetic permeability due to the mixture ratio of the magnetic carriers (C for short) and the nonmagnetic ~~non-magnetic~~ toner (T for short) changes when the toner density of the developer 43 (the rate of the toner particle weight with respect to the total weight of the carrier particles and the toner particles) changes. When the apparent magnetic permeability is detected by the inductance head 20 and then converted into an electric signal, the electric signal (sensor output voltage (v)) is substantially linearly changed in accordance with the toner density (T/C ratio (t)) as shown in Fig. 4. That is, the electric signal outputted from the inductance head 20 corresponds to an actual toner density of the two-component developer within the developing device 44. The electric signal outputted from the inductance head 20 is supplied to one input of a comparator 21. The other input of the comparator 21 is inputted with a reference electric signal corresponding to the apparent

magnetic permeability of a regular toner density (the toner density in an initial set value) of the developer 43 from a reference voltage signal supply 22. Accordingly, the comparator 21 compares the regular toner density with the actual toner density within the developing device 44, and a detection signal of the comparator 21 as the comparison result of both of the input signals is supplied to a CPU 67 serving as a control means.

The paragraph starting at page 21, line 13 and ending at page 22, line 5 has been amended as follows.

Also, in the inductance detecting system ATR used in this embodiment, the reference value of the detection signal in an optimum toner density (The optimum toner density is 6% in this embodiment. If the toner density is higher than that value, the toner may be scattered whereas if the toner density is lower than that value, the light image may occur.) is set to 2.5 V. If the detection signal of the sensor is larger than the reference value (for example, 3.0 V), the toner is replenished, and if the detection signal of the sensor is smaller than the reference value (for example, 2.0 V), the replenishment of the toner stops. However, the present invention is not limited to the above-described ~~above~~ signal processing, but the circuit structure may be modified so that the reference value becomes a value of 2.5 V or more. Also, the detection signal of the sensor when the toner density is lower than the optimum value may be set to be smaller so that the detection signal of the sensor may become larger when the toner density is higher than the optimum value.

The paragraph starting at page 25, line 11 and ending at page 26, line 18 has been amended as follows.

First, as shown in Fig. 1, the detection signal from the inductance head 20 immediately before the operation of the image forming apparatus stops (for example, after a final image formation has been completed and immediately before the main switch of the image forming apparatus turns off; before the main switch turns off and during the final image forming operation; or before the waiting state of the image forming apparatus) is stored in a recording saving device 23 such as a nonvolatile ~~non-volatile~~ memory (storing means). Then, immediately after the operation of the apparatus restarts (for example, after the main switch of the image forming apparatus turns on and before an initial image formation is conducted after the main switch turns on and during the initial image forming operation; or immediately after the image formation start signal is inputted and the waiting state of the image forming apparatus is completed and before the image formation is conducted on the basis of the image formation start signal), the detection signal immediately before the operation of the apparatus stops which is recorded in the recording saving device 23 is supplied to one input of a second comparator 24, and the detection signal is inputted to the other input of the second comparator 24 from the inductance head 20 immediately after the operation of the apparatus starts, and its difference value is transmitted to a second CPU 25 that serves as a selecting means (control means). The second CPU 25 judges whether the subsequent developer density control is sequentially conducted by only the first density controller of the inductance detecting system on the

basis of the above difference value, or whether the operation is changed over to the second developer density controller of the video count system.

The paragraph starting at page 27, line 21 and ending at page 28, line 2 has been amended as follows.

In this embodiment, since the detection signal of the developer controller immediately before the operation of the image forming apparatus stops is stored in a nonvolatile ~~non-volatile~~ memory, even if the main power supply of the image forming apparatus is left in a switched-off state, the detection signal from the inductance head after the operation of the apparatus restarts and the above memory value can be compared with each other.

Please insert the following new paragraph on page 31 after line 14.

The above operation is illustrated in the flowchart shown in Fig. 9. In Step S1, in the image forming apparatus, a difference value obtained by the inductance sensor is transmitted to CPU 25. In Step S2, the value of N is changed in accordance with the difference value. In Step S3, a predetermined period of time $N \times t_2$ is calculated. In Step S4, the CPU 25 selects between a main mode and a sub-mode based on the difference value. In Step S5, label Fig. 9 in the sub-mode and after the predetermined period of time

$N \times t_2$ has elapsed, the apparatus returns to the main mode if the predetermined period of time has not elapsed the apparatus returns to the sub-mode.

The paragraphs starting at page 33, line 5 and ending at page 34, line 15 have been amended as follows.

Under the above-described ~~above~~ circumstances, in this embodiment, control is made in such a manner that the change-over of the developer density control of the video count system to the developer density control of the inductance detecting system, or the using of the developer density control of the inductance detecting system and the developer density control of the video count system together, is returned to the original developer density control of the inductance detecting system after a predetermined period of time elapses. As a result, the developer density control immediately after the bulk density is remarkably changed due to the leaving of the developer as well as the subsequent developer density control in a state where the correlation relationship between the detection signal from the inductance head and the actual toner density substantially coincides with each other after the bulk density is stabilized due to a large amount of image forming operation, can maintain the developer density within the developing container at a predetermined value.

The above-described ~~above~~ predetermined period of time is determined on the basis of the number of image formations, and the change-over to the developer density control of the inductance detecting system, or the developer density control using the developer

density control of the inductance detecting system and the developer density control of the video count system together is returned to the developer density control of only the inductance detecting system after the images are formed on, for example, 100 sheets of transfer materials. As a result, the developer density control immediately after the bulk density is remarkably changed due to the leaving of the developer, as well as the subsequent developer density control in a state where the bulk density is stabilized due to a large amount of image forming operation can be controlled to a desired value.

The paragraph starting at page 38, line 26 and ending at page 39, line 7 has been amended as follows.

The shape factor of the spherical polymer toner obtained through the above-described ~~above~~ method is 100 to 180 in SF-1 and 100 to 140 in SF-2. The SF-1 and SF-2 are defined as values obtained by sampling 100 toners at random by using FE-SEM (S-BOO) made by Hitachi, Ltd., introducing the image information to an image analyzing device (Luzex3) made by Nicolet Japan Corporation through an interface, analyzing the information and conducting calculation on the basis of the following expressions.

The paragraph starting at page 41, line 25 and ending at page 42, line 9 has been amended as follows.

The above-described ~~above~~ fact can reduce a change in the bulk density of the developer due to a change in the shape of the toner, or a change in the toner charge amount due to the developer compression, to thereby lead to a reduction in the change of the bulk density due to the repulsion between the developers. The error in the sensor detection signal immediately after the operation of the device restarts can be reduced in the inductance detecting system ATR as compared with the conventional system where the developing sleeve rotates in the forward direction with respect to the photosensitive drum as in the conventional example.

The paragraph starting at page 42, line 13 and ending at line 19 has been amended as follows.

The feature of this embodiment resides in that a change in the toner charge amount is reduced by changing the material and physical property of the carriers in the developer in the above-described ~~above~~ embodiment. The structure of the image forming apparatus can be applied with the structure of the first to fifth embodiments except for the structure of the carriers, likewise.

The paragraph starting at page 43, line 21 and ending at line 26 has been amended as follows.

The high resistant carriers in this embodiment are produced by the polymerizing method as a resin magnetic carrier consisting of a binder resin, a magnetic metal oxide and a nonmagnetic ~~non-magnetic~~ metal oxide. However, if the resistance can be adjusted by another manufacturing method, its carriers may be used.